FUEL CELLS

RENEWABLE ENERGY PROGRAM

CALIFORNIA ENERGY COMMISSION

A fuel cell generates electricity through an electrochemical process in which the energy stored in a fuel (hydrogen, natural gas, methanol, landfill gas (methane), propane, etc.) is converted directly into direct current (DC) electricity. Electricity is generated by the chemical reaction between hydrogen and oxygen (air). There are three sections of the typical fuel cell power system: a fuel processor; the power section (fuel cell stack); and the power conditioner section. Although discovered in 1839, fuel cell technology was never put into use until NASA began using fuel cells in the 1960's, and they have since been used in the Apollo, Gemini and space shuttle programs. Fuel cells provide heat, drinkable water, and reliable, silent electrical power.

A fuel cell is similar to a battery. It uses an electrochemical process to directly convert chemical energy into electricity and hot water. Like a battery, a fuel cell has reactions taking place at the anode (positive) and cathode (negative) to supply DC electricity. But unlike a battery, a fuel cell doesn't store energy or require recharging. Only hydrogen and air are needed for continuous fuel cell operation and electricity production

Pictured at top is a proton exchange membrane (PEM) fuel cell stack, and at bottom, a molten carbonate fuel cell (MCFC) stack.

When a fuel other than pure hydrogen is used, like natural gas, it is processed to boost the concentration of hydrogen. The hydrogen-rich fuel and oxygen goes into the power section and produces DC electricity, reusable heat and water. The power section includes a fuel cell stack which is a series of electrode plates, interconnected to produce a set quantity of power that can be varied by the size of the fuel cell stack. The output DC power is then converted to alternating current (AC) in the power conditioning section of the fuel cell system so the electricity can be used in businesses and homes. Because electrical energy can be generated without burning fuel, fuel cells are very environmentally friendly.

Fuel cells operate independently from the electrical grid in times of electricity outages or "brown-outs," which occur when there is too large a load from too many users placed on a power supply system. The National Power Laboratory estimates that the typical computer location experiences almost 300 power disturbances a year that are outside the voltage limits of the computer equipment. Many businesses which rely on high-grade, computer-quality power can ensure their operations are not affected by power outages by having an on-site fuel cell power plant.

For more information, contact the California Energy Commission Call Center at **1-800-555-7794** or visit our Web Site at: **www.energy.ca.gov/renewables**

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